Pin Dome Metrology

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Heterodyne Workshop
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Pin Dome Metrology

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Goal

- Define measurements required of optical probes in a pin dome configuration.
- Develop techniques and methods for optical measurements.
- Develop data database linking optical measurements with pin dome measurements.

Definitions

Metrology: The science of measurement; a system of weight and measure

Pin Dome: Diagnostic device consisting of many (100–400) shorting pins (stiff wires) arranged in radial configuration. Pins are arranged at a variety of heights (radius). Pin domes measure the interior of an implosion device.

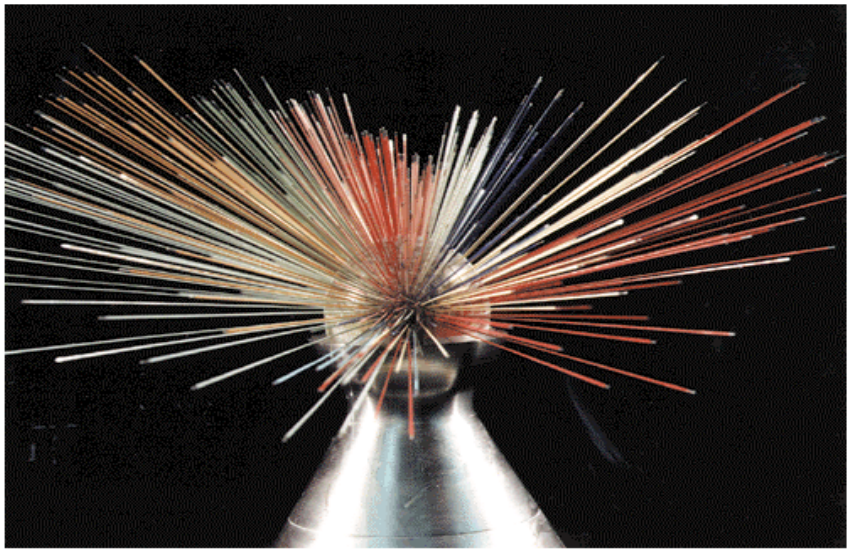


Figure 6. The fiber-optic "pins" on this pin dome receive velocity and symmetry information while a test device implodes.

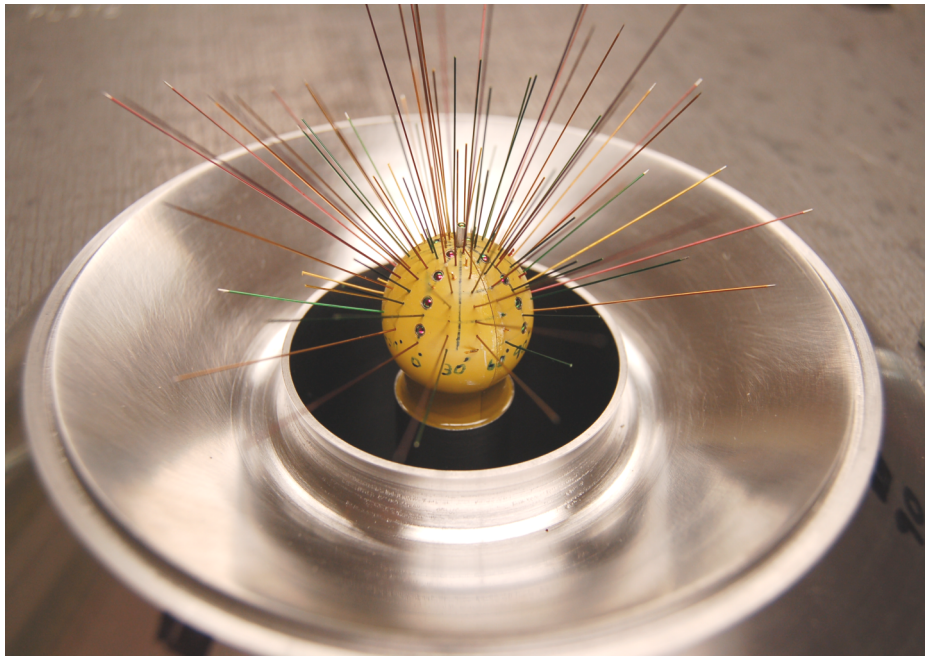
Definitions

Origin: The absolute center of a dome device.

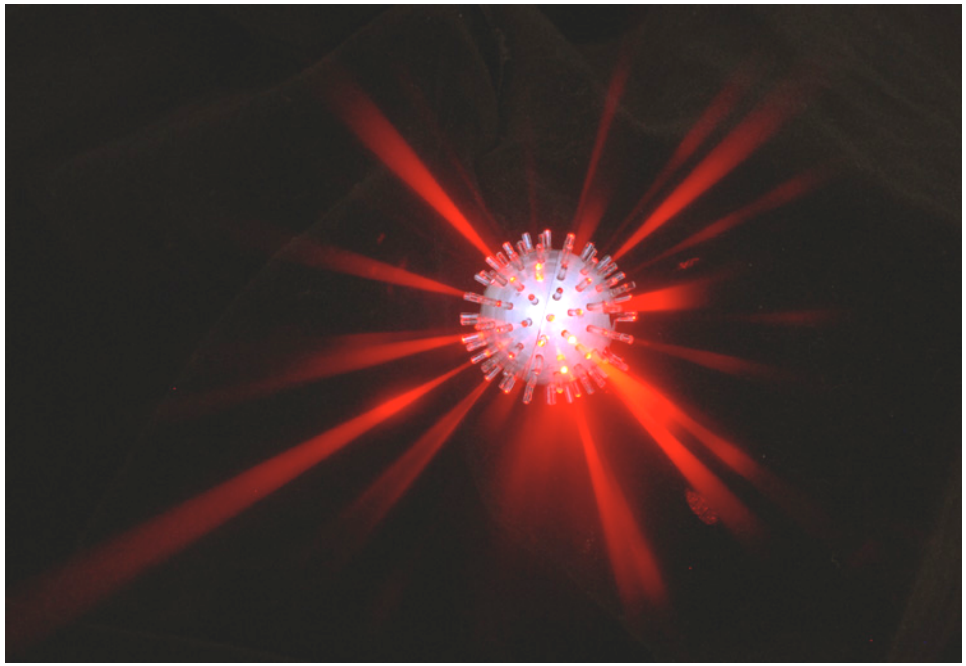
Hybrid Dome: A dome consisting of electrical shorting pins and optical probes (PDV-VISAR).

Optical Dome: A dome consisting of all optical probes.

Hybrid Dome



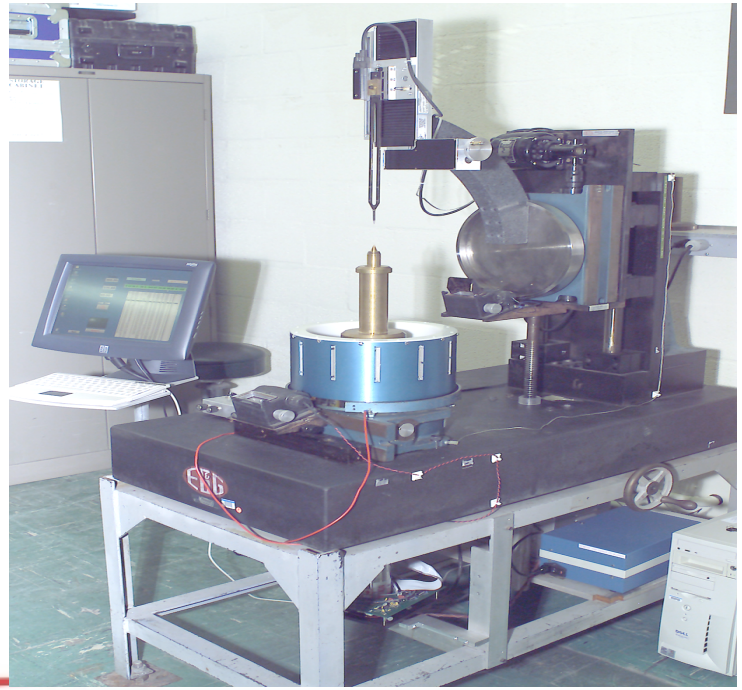
Optical Dome



Pin Metrology

Historical Pin Measurements:

- *Radius*: Tip of pin wire with respect to origin.
- *Azimuthal Angle*: Rotational angle (longitudinal) as you view dome from top with respect to origin.
- *Elevation Angle*: Rotational angle (latitudinal) as you view dome from side with respect to origin.



Metrology Differences

- Pins use electrical contact (needle probe) method.
- Optical uses non-contact methods (lasers, OTDR, radiometer).

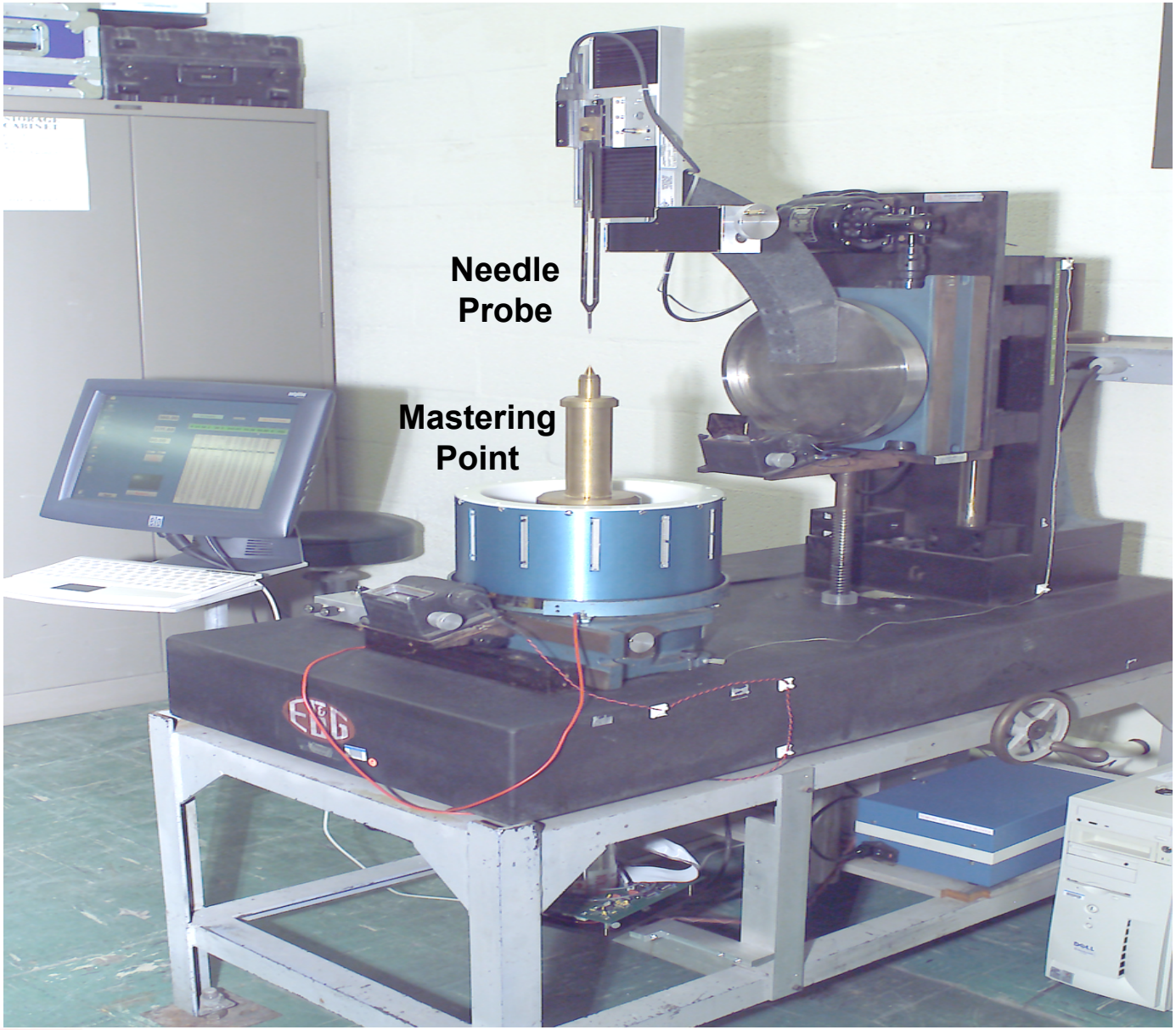
- Pins measure a single point in space (tip of wire) relative to origin.
- Optical measures ray (line in space) relative to origin.

- Pin metrology has a long history (large data base) - 50 years
- Optical metrology is in the developmental phase - No database

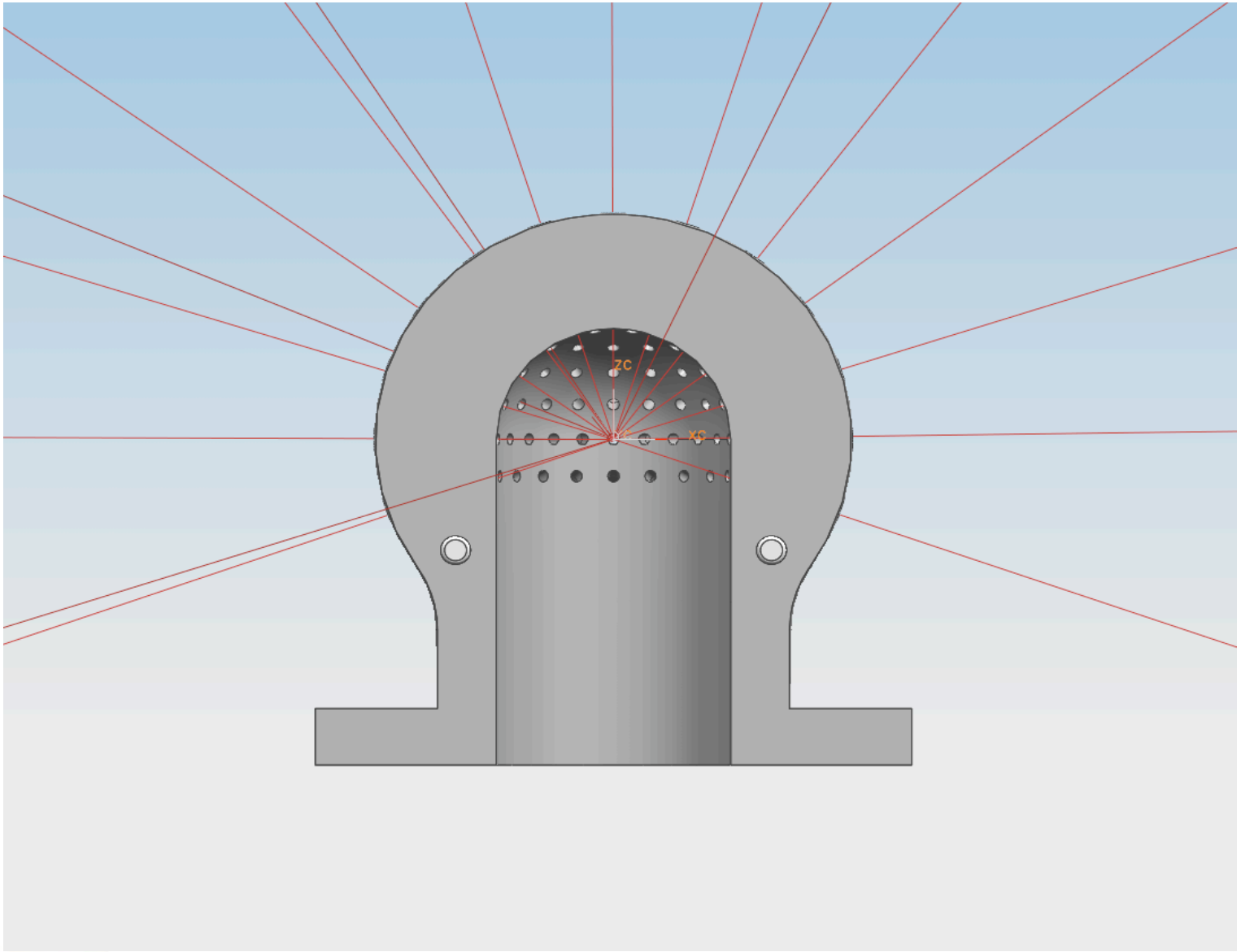
IMPORTANT NOTE

It is “critical” that the metrology “techniques” be linked together. New optical methods need to be able to integrate into current pin measuring systems.

Current Pin Measuring Unit



Ideal Dome



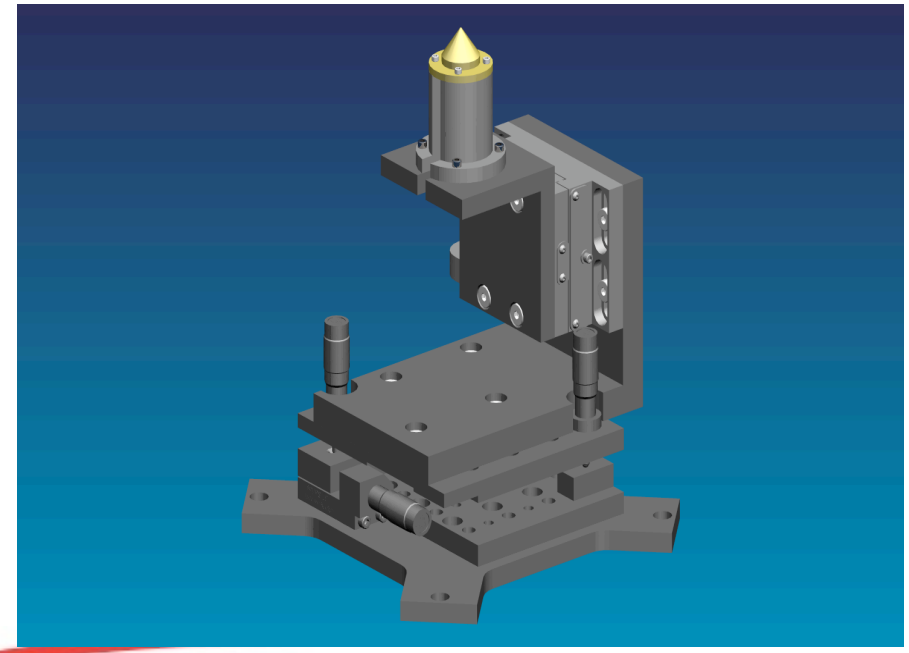
Dome Metrology

Common to Pins and Optical Probes

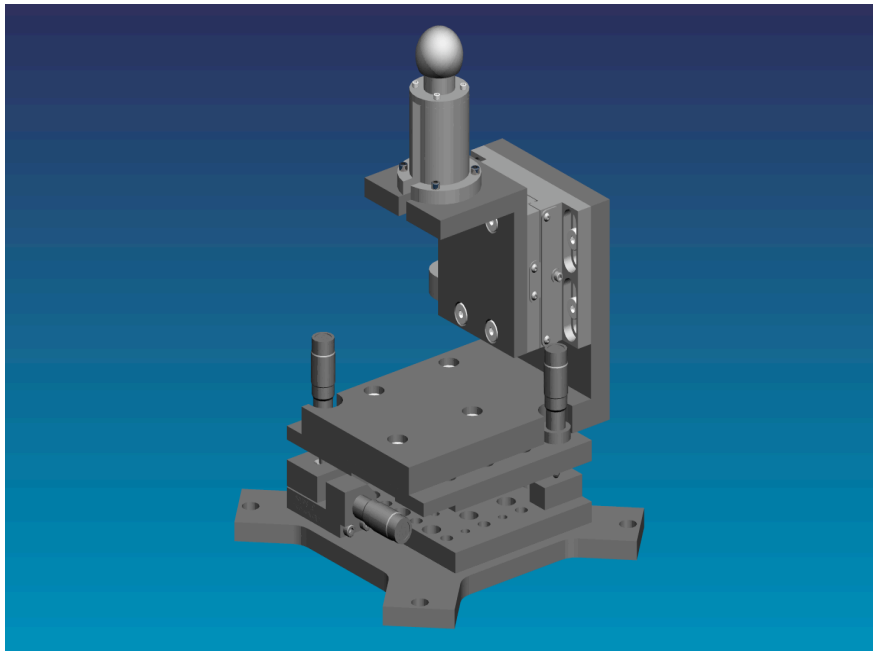
Machine "Mastering"

- Calibrate needle probe to origin using "point" target
- Calibrate machine to NIST traceable sphere

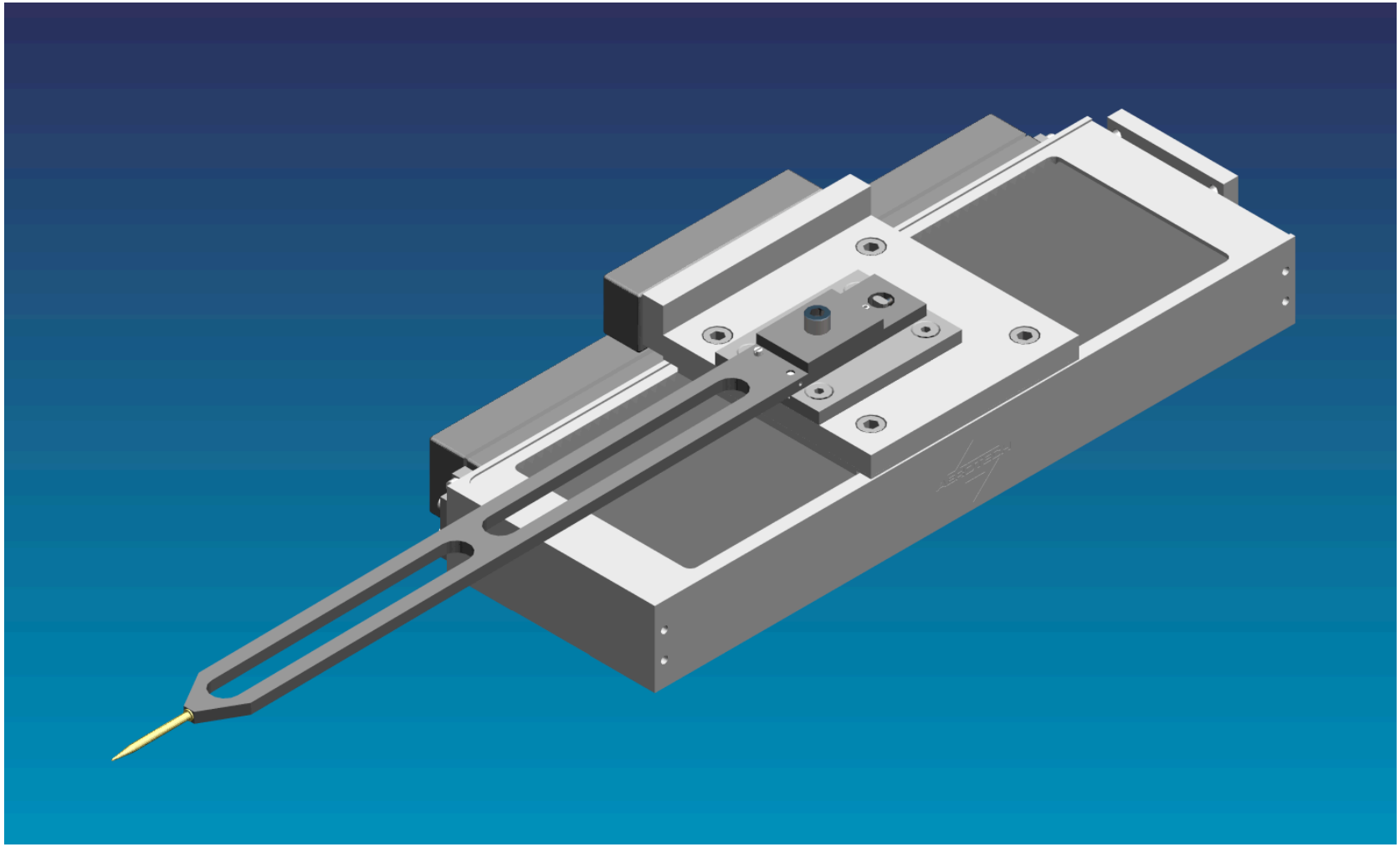
Point Calibrator



Ball Calibrator



Hybred Needle Probe



Optical Measurements

- *Azimuthal Ray:* Line defined by optical probe with respect to origin. Measured in two axis (longitude, latitude).

- *Probe Face To Origin:* Measured using latest OTDR techniques. Probe position is necessary when applied with "proximity" measurement.

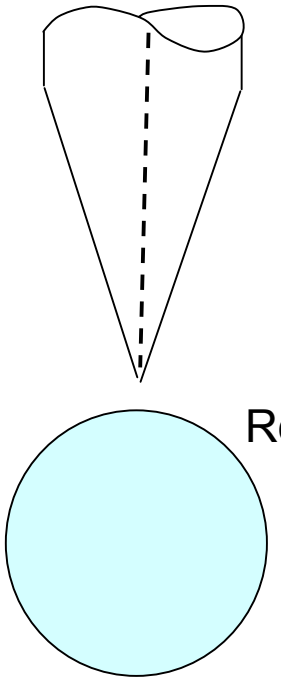
- *Proximity Measurement:* Measurement of dome inside of test device.

Note: Accuracy of angular measurement is ± one arc second (1/60th of one degree). Accuracy of distance measurement is ±5–10 μm.

Calibration Procedure

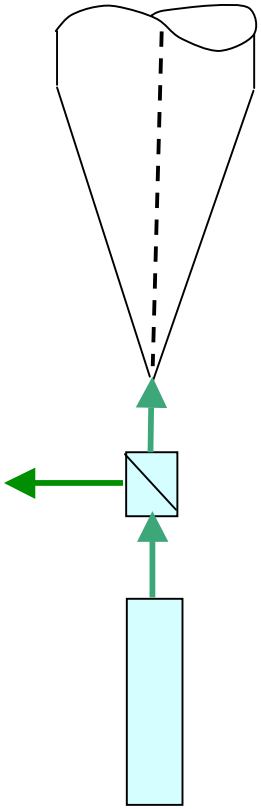
Step 1

Hybrid probe fiber is dashed

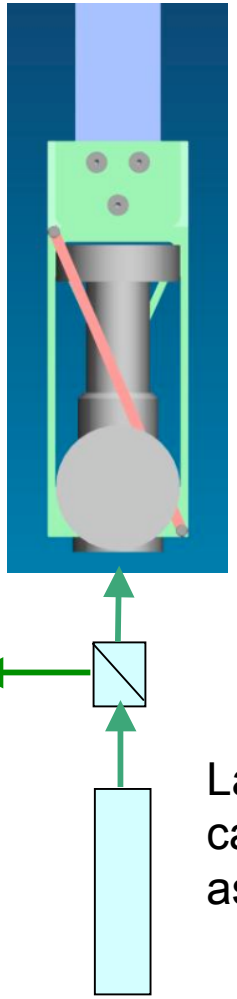


Ref. sphere

Step 2



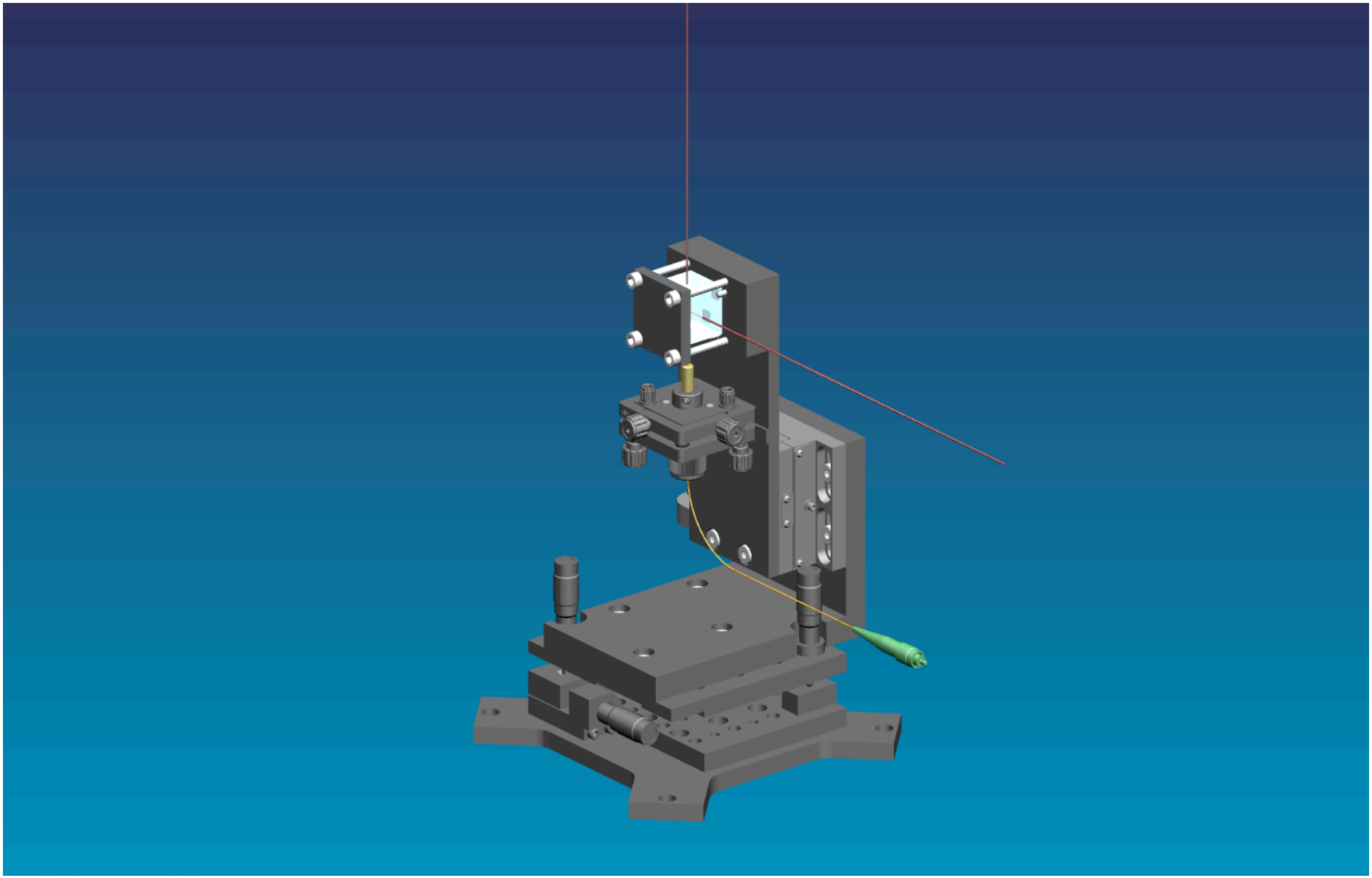
Step 3



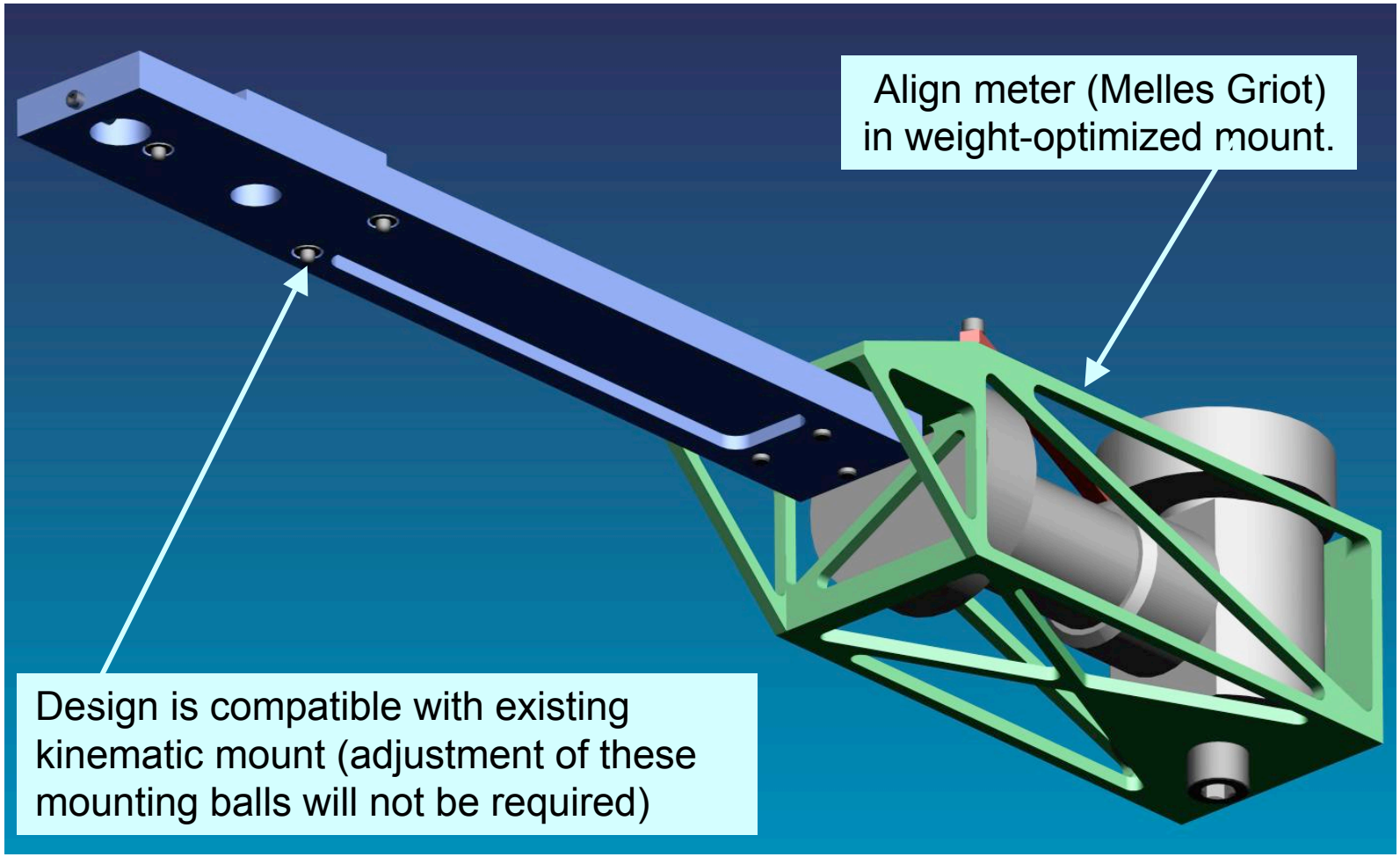
Align meter

Laser calibration assy

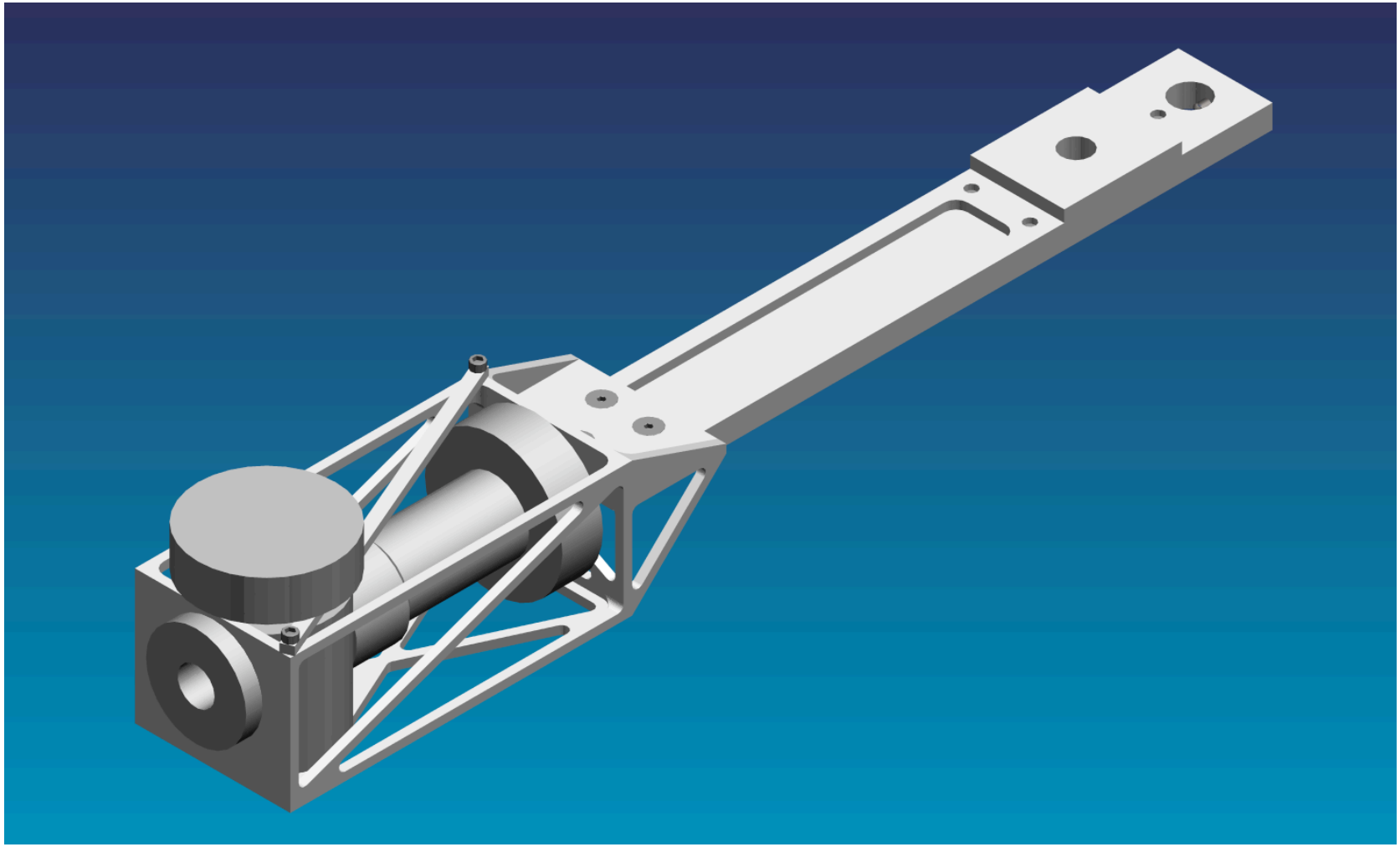
Alignment Laser



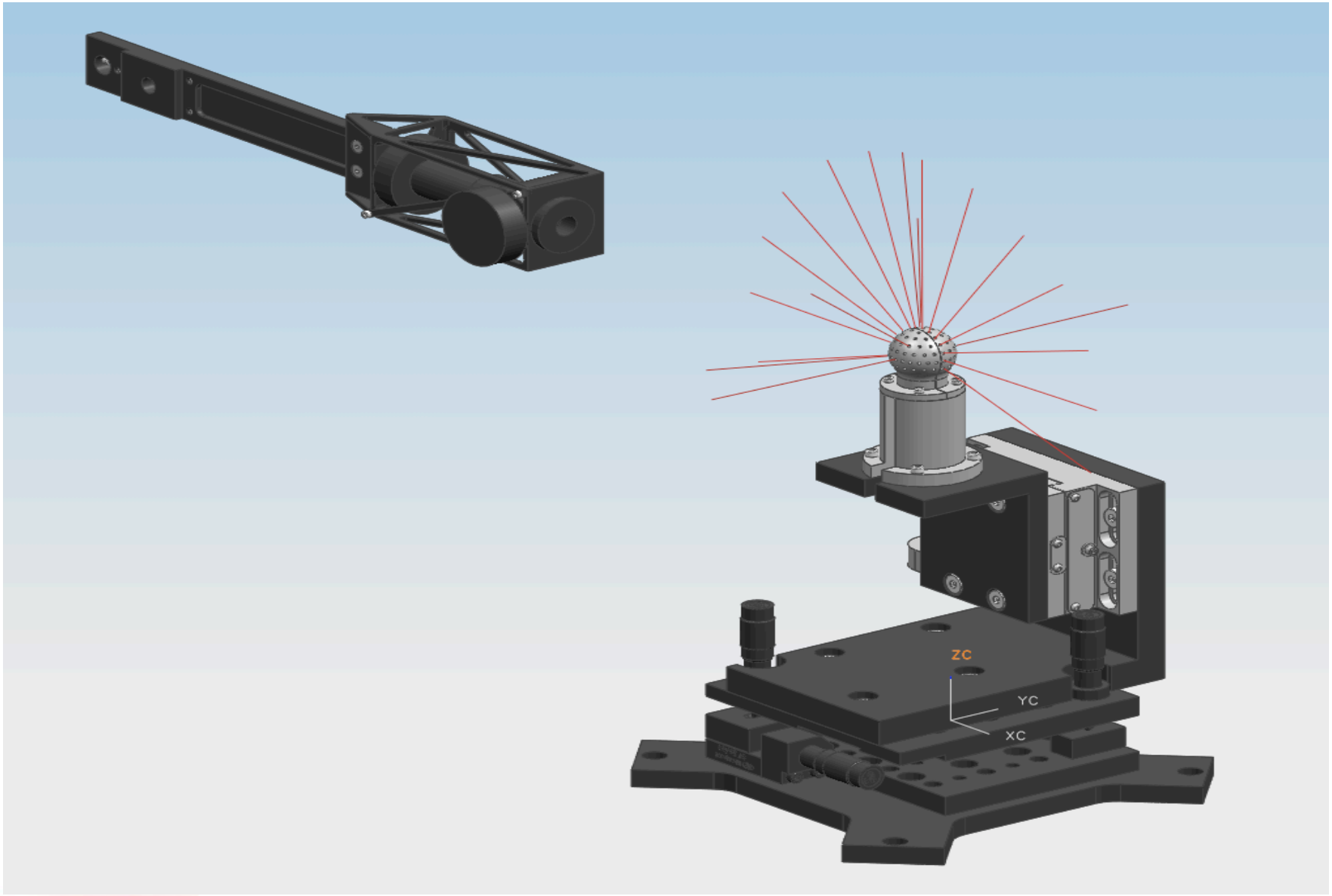
Design


Align meter (Melles Griot) in weight-optimized mount.
Design is compatible with existing kinematic mount (adjustment of these mounting balls will not be required)

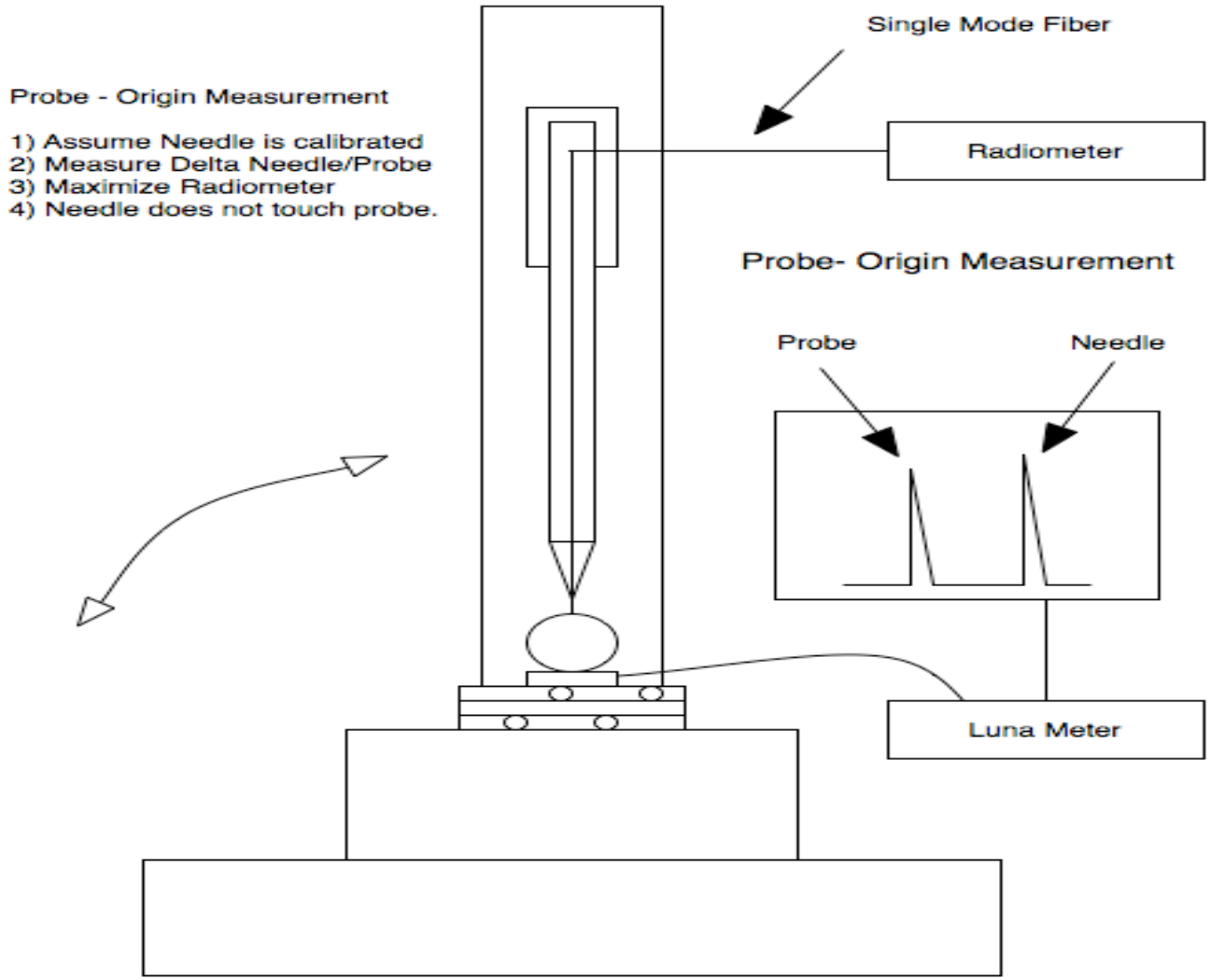
Angle Measurement Unit



Azimuthal Ray Measuement



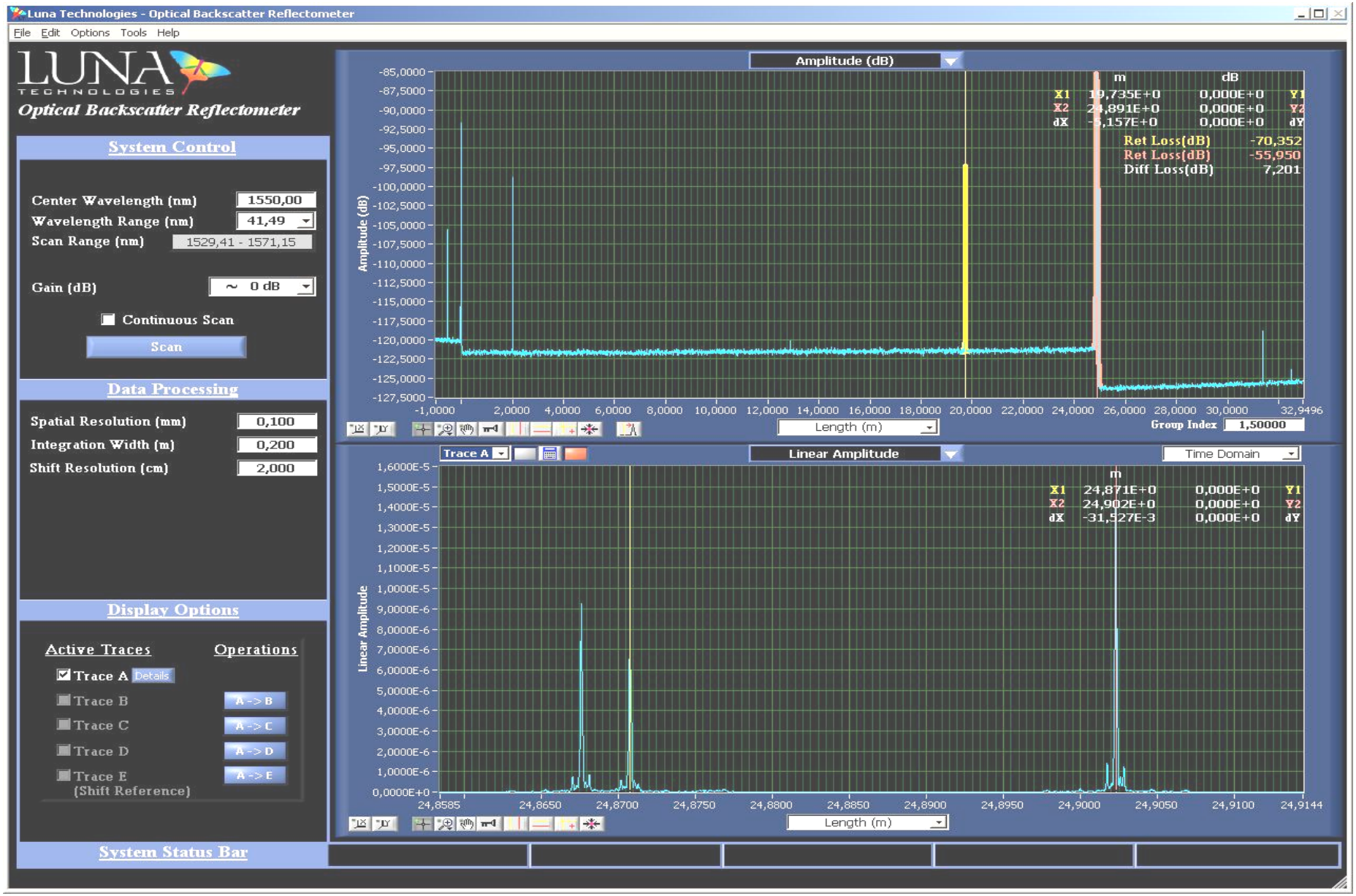
Probe Face to Origin Measurement



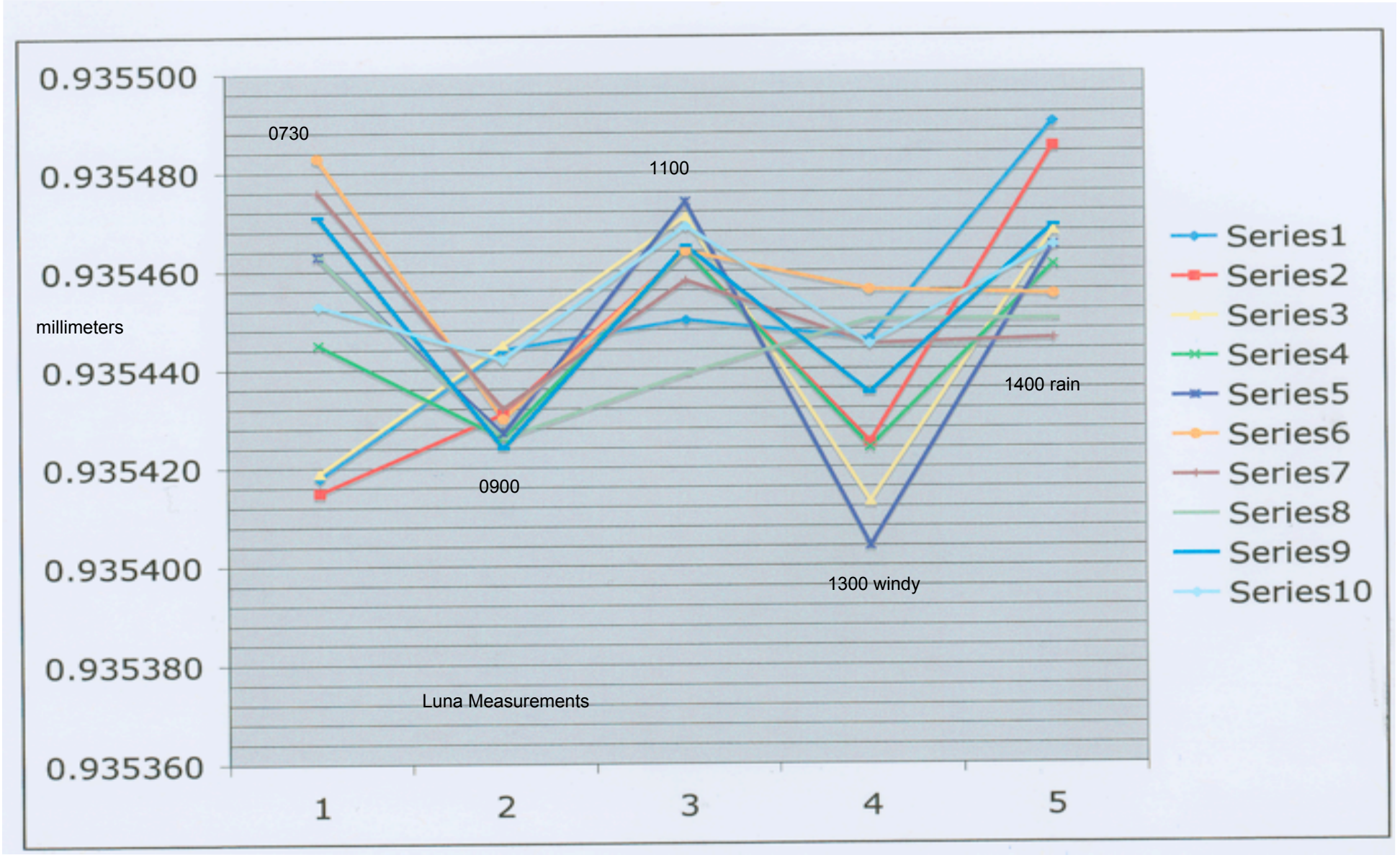
Pin Dome Alignment 4-16-07 VTR

Proximity Measurement

Proximity Measurement



Proximity Measurement



Conclusion

- Initial Optical Metrology encouraging
- Accuracy of ± 15um obtained.(Surface Proximity)
- Accuracy of ± 1/60th of a degree obtained.
- Link between optical probes and pin probe obtained.
- Improvements of future measurements possible. (± 10um)
- Demonstrated “real-time” proximity in hydro device.
- Automation of measurements possible.

Questions?